

Patterns of Herd Behavior in Free-ranging Elk of Wyoming, *Cervus canadensis nelsoni*

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(Text-figures 1-5)

IN A long-range study¹ continuing over seven years, an attempt was made to analyze the social patterns observed in groups of elk, or wapiti (*Cervus canadensis nelsoni*), of the Jackson Hole herd in the upper drainages of the Snake and Buffalo rivers and the adjacent slopes and drainages in Wyoming.² Some of the results are presented in this paper.

Elk live in herds, have migratory habits and are relatively free-ranging in their struggle for food and safety. Their group and individual interaction is mostly by signals rather than by physical contact enforcement, a matter of particular interest because little work in this area of study has been reported.

From the numerous observations made, some definite patterns of herd behavior and structure emerged. They varied with the season and were studied at spring migration, during the period the elk spent on summer range and during the rutting season. Within the elk herd forms of communication are vocal and by means of gestures rather than by contact as in buffalo (*Bison bison*). For example, threats concerning behavior within the group are usually at first gesture signals, such as lifting the front leg or lifting the head and folding the ears back. The members of a group seem to react to such signals over distances up to approximately 250 feet and members of other groups will retaliate with the same gesture. In meeting animals of other species, the elk's signals or gestures are at times not respected or understood. On one occasion a Hereford calf accidentally joined an elk nursery herd and although it was threatened with lifted front legs

by the nearest cow elk, it did not retreat until it was actually hit by the elk.

Among vocal communications of the groups, bugling in the nursery herd in spring, as reported by Murie (1951) and by Altmann (1950), is an unusual sound. It was found that in cases of concern, but when no direct scent of danger is noticed, cow elk occasionally bugle in spring, apparently as a warning and challenge, in combination with head shaking up and down and stamping of the front feet. Bugling is otherwise strictly reserved for bull elk during the rutting season. Uncertainty about a visible intruder is frequently expressed by a short snort or bark which startles the rest of the group into attention. Vocal and gesture signals are often coordinated and expressed simultaneously. Vocal expression, however, does not always serve as a signal of danger or challenge in the elk herd. At times, for instance in the nursery herd, a cow-to-calf and calf-to-cow call serves as a bond of security when the movements of the herd temporarily widen the distance between dam and calf.

I. SPRING MIGRATION

The patterns at spring migration time were difficult to establish. Many years of consecutive observations were required because of the complexity and variation of the situation. The giant group of elk, more than 10,000 in number, containing males and females in random association, assembles for winter feeding in the National Elk Refuge at an altitude of 6,500 feet. With the beginning of early spring and the snow-melt, the big aggregate gradually breaks into subgroups of smaller and smaller numbers. These subgroups drift away from the flat pastures to hillsides and valleys upstream and begin to migrate close on the receding snowline or on slopes still covered with snow.

¹See previous Altmann publications in Bibliography.

²This research is being sponsored by the New York Zoological Society and is carried out from headquarters at the Jackson Hole Biological Research Station of the University of Wyoming at Moran, Wyoming.

At the approach of the calving season in late May and early June, the pregnant cows drop out of the formation and seek separate trails to secluded calving areas. They usually take the yearlings with them.

The rest of the groups, now predominantly males, migrates toward higher altitudes. These bull groups remain separate during most of the summer until the beginning of the rutting season in September. The bull groups are usually small to medium in number, ranging from two to sixteen head. There is great tolerance toward the spike bulls, extending up to velvet-rubbing time between sparring partners.

With the segregation of the cows on the calving grounds the pattern of the nursery herd begins to be shaped. The herd size is usually medium, twelve to thirty cows. A typical pattern in the nursery herd is described below. At the time of giving birth the cow stays near the herd, but seeks a secluded corner or sheltering clump of trees. The newborn calf is usually hidden for one to two weeks. It is left by the cow for various lengths of time while she is grazing.

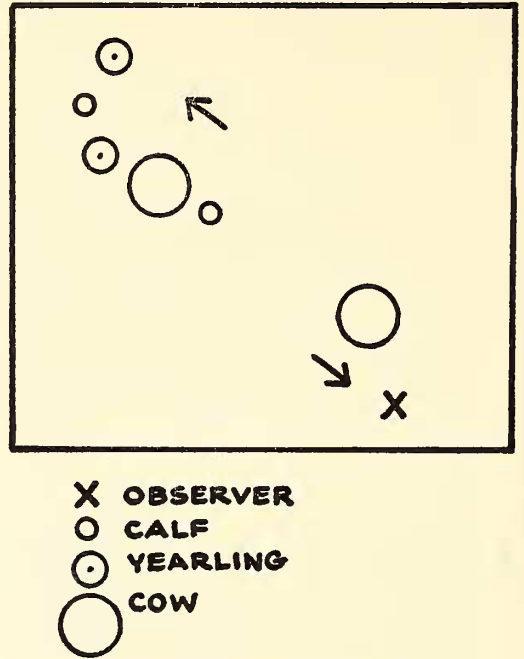
After the first nursing, the calf either drops down to a resting position or is pushed down by the cow. While its mother grazes it remains in quiet position until the next nursing, and any attempts to get up and stagger around are cut short by the cow. The calf may stay in this position from twenty minutes to six hours, or even longer.

It was noted that a push with a front foot was at times necessary to subdue the calf, but in most cases the mere approach or threatening gesture of the cow seemed sufficient to make the calf lie down and stay put.

Rigidity in this down position is the rule when the calf is disturbed by an intruder; not even the ears are moved. Occasionally it was observed that the calf's eyes were moving while following an intruder. When the disturbance had passed the calf relaxed and the ears moved freely to drive off insects.

Little vocalization was observed in the very young elk calf up to two weeks of age.

Cooperative protection of young calves was found to occur in guarded "calf pools." One or two cows serve as guardians and stay with the young while the others graze and return at intervals for nursing and licking their calves. The location selected for such pools is usually a meadow with aspen stands, favorably sloping to the morning sun. When a calf is about three weeks old it is able to follow the herd, and it leaves the calf pool and in general joins the herd activities. It takes longer rest periods than the adults, however.



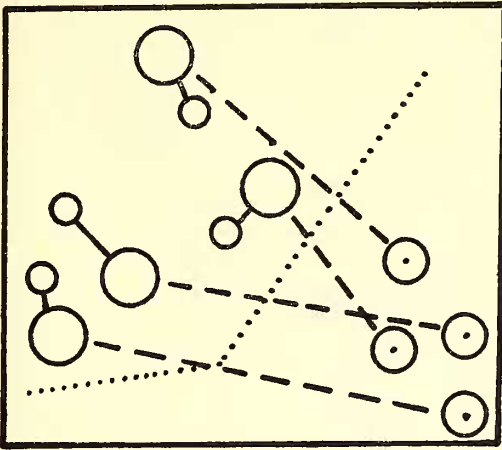
TEXT-FIG. 1. Shielding pattern.

A typical pattern of shielding the calf in case of disturbance by human beings (Altmann, 1953) is depicted in Text-fig. 1. Cow elk with calves and yearlings moved slowly through a meadow. Grazing, they got scent of the observer and the horse. One of the cows, apparently the leading individual, turned and approached the observer slowly in high-stepping gait. The others, shielding the calves, disappeared in the opposite direction in rapidly moving single file.

As soon as calves are born, the yearlings are driven into an outer or marginal zone by their mothers. The rejection of last year's calf, the yearling, is shown in Text-fig. 2. If the yearlings venture too close to the cows they are struck with the fore feet. In most cases this enforcement is not necessary, because the yearlings yield to a gesture of the cow which consists of folding the ears back and raising the head and one front foot.

Migration of the nursery groups continues as soon as the calves have rejoined the herd formation and are able to keep up in speed, cross streams and follow herd signals. The increasing intervals of time between nursings allow for longer stages on the migratory route.

Some period of training the calves for water crossings was repeatedly observed. The cows sought out quiet, shallow side arms of the rivers and by splashing games they made the calves familiar with the water. The youngsters enjoyed the games. Squealing calves jumping and run-



- **LINE OF TOLERANCE**
 ○ **CALF**
 ⊙ **YEARLING**
 ⊚ **COW**

TEXT-FIG. 2. Rejection pattern.

ning through the water were regularly observed on the days before major crossings through high water were undertaken by the herd.

Initiative is exhibited by mature cows when crossing obstacles during migration to the high summer ranges. Highways with traffic, fences and streams and feedless areas are the normal obstacles on this route. If part of a herd during migration is delayed because of a disturbance, the split-off group usually searches, sometimes for hours or even days, for the others, or simply waits. Such a group will smell and look intensely at other elk passing by but still wait for the original group to which it belonged.

Dangerous, swift streams are crossed by elk groups in protective formation. A typical example of this is shown in Text-fig. 3. Cows swam below the calves in the current, thus preventing their being swept away downstream. In entering the stream the calves sometimes were pushed into the upstream position by the dams. Stream crossings took place most frequently in the morning hours when usually the streams were less swollen than later. When fatigue or obstacles on the trail bring the group to a halt, the calves, frequently in unison, begin to nurse. Sometimes the nursing is initiated by one calf and then the whole group takes it up.

Weaning is very gradual and extends up to the fall season. There were, in general, no nursing elk calves seen after the onset of the rutting season. In a few cases where a calf had been

dropped exceptionally late, the elk cow was still lactating while the rutting season was under way.

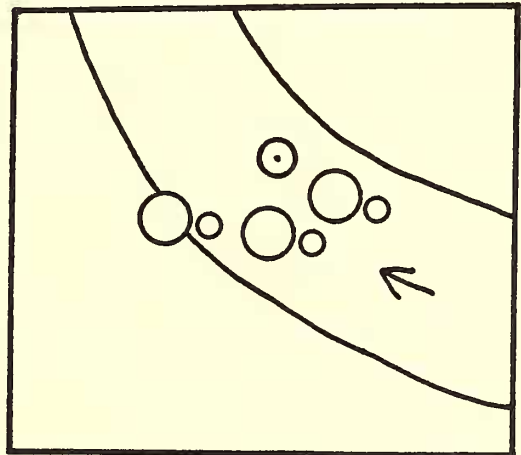
II. ON SUMMER RANGES

Four summer range plateaus were under observation. They comprised about ten to sixteen square miles each and ranged in altitude from 8,700 to 10,000 feet.

The cool temperature and freedom from insects and other disturbances on these summer ranges bring a characteristic change in the elk routine as observed at all other seasons. On the summer range the elk rest at night and sleep until after sunrise. They graze during a large portion of the day.

Considerable uniformity of behavior patterns was found to exist in the elk on high summer ranges in successive years (1948-1954). Some of the swiftly migrating groups of bulls reached the summer range when it was still in its snow-covered stage. Sunny south slopes allowed for early summer grazing, but feed was often scarce.

The small size of the bull groups (two to seven) made it possible for them to utilize small patches of exposed grass vegetation. The bull groups, once on the high range, were bold and exposed themselves on the ridges as well as on the slopes. The flight distance to human beings was very low and the bulls could be observed with little difficulty even when sleeping or resting.

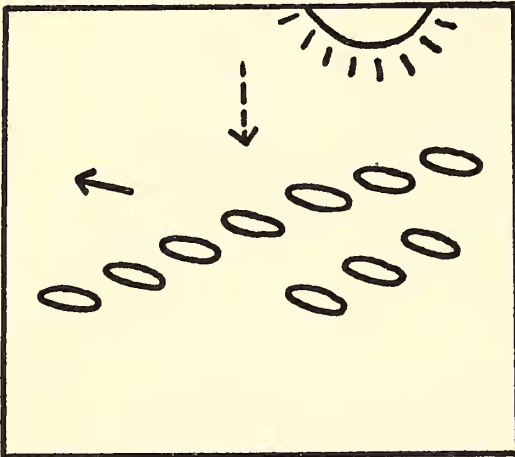


- **CALF**
 ⊙ **YEARLING**
 ⊚ **COW**
 ← **WATER CURRENT**

TEXT-FIG. 3. Crossing a river.

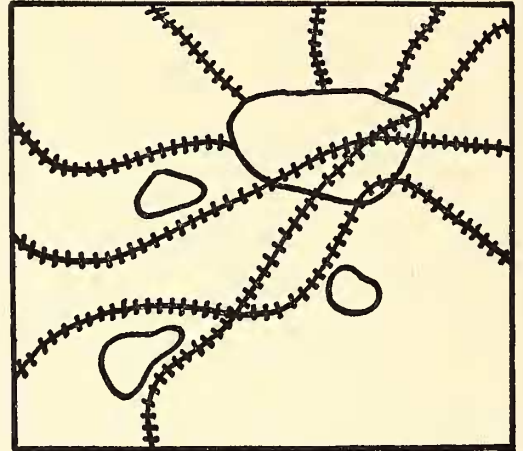
Tolerance for the younger bulls, two and three years old, by the big-antlered, mature bulls was complete in this phase. Because of the soft velvet on their growing antlers, tussling or mock fighting was rare. Most of the time was spent in grazing the short vegetation, but baths in snow-drifts and evening expeditions to salt or alkali licks were also the rule. One can spot the dominance order of the group only then, when obstacles or limitation give the opportunity. Examples are the passage on a rock-bound trail or the most desired place at the lick. No leadership in respect to safety is displayed in case of disturbance. A surprised bull group will break away in a disorganized way, and sometimes a younger, sometimes an older, group member may run first.

The bands of cows with calves and yearlings begin to arrive in increasing numbers following the arrival of the bulls. At first these migratory units keep to themselves but soon the groups melt into larger units of twenty to forty animals until a very large herd up to a thousand head is formed. Grazing is then done in spread out fashion, and many calves congregate to play and rest together rather than heel their mothers. An often-seen grazing pattern on the summer range is the "windrow formation" which at first puzzled me very much. This formation (Text-fig. 4) is in evidence when a fresh cool wind and sunshine coincide. In bad weather the elk graze in cluster formation or stop eating and seek shelter behind and in the dense fir aggregates.



○ ELK
 ← DIRECTION OF GRAZING
 ↓ DIRECTION OF WIND

TEXT-FIG. 4. Windrow formation.



— ELK TRAIL
 ○ MINOR LICK
 ○ MAJOR LICK

TEXT-FIG. 5. Salt lick.

At times of sudden storms, the elk quickly entered the shelter places and the younger (yearling) and lower-ranking individuals were chased from the best locations while calves were taken in by the cows. Such dominance tests occurred only when the number of elk in the group was larger than could be accommodated by the available space under cover. The rejected minor elk moved to more distant places of shelter or stayed nearby under wind cover. Actual contact and fighting were not observed, and displacement was accomplished by mere gesture. In cows, the gesture of threat consisted of empty beats with the front feet. In bulls a shaking of the antlers with lowered head was the gesture of threat.

Big nursery herds into which the bull groups only rarely or temporarily were incorporated, rested in the bottom of the plateaus or slopes on cold days, on the upper ridges or wind-blown top slopes in hot weather. In a typical nursery herd on summer range, one or several mature cows usually located themselves in a place where approach ways could be watched. This was the general rule, but did not always hold. It was sometimes observed that smaller branch-groups, grazing on side slopes or on expeditions to nearby alkali licks, also served as safety scouts against intruders. Their flight reaction or signal alarmed the big herd and cleared the whole summer range plateau. In the case of such a general alarm, the herds on summer range were

found to move to a number of "secondary" slopes, which were frequented mainly in cases of disturbance. These secondary slopes permitted a view of the main plateau, to which the elk usually came back after the disturbance had disappeared. There was, however, a time margin of safety, which lasted from several hours to several days after the disturbance.

On the summer range, time devoted to play activity was related to the amount of food available to the herd. In early and late summer, most time was spent in search of food. The games of calves (Altmann, 1952) were also seen on the summer range, but included the whole herd or at least most of the group on the high plateau. Sometimes the snowdrifts³ formed the playground, sometimes a green meadow or a pond. Splashing and squealing in the sun, the calves went through the ritual with noisy unconcern. A comparison with elk groups living in especially poor habitat showed that elk calves did not play under the latter conditions and that the whole herd was more nervous, had a high flight distance and fewer vocal expressions.

At dusk and occasionally on moonlit nights the herd descended from the summer range to the big alkali licks on the steeper slopes below the plateau. A widely branched system of trails was discovered (Text-fig. 5) leading to and from the salt licks. Observation revealed the almost formal procedure which elk groups use in entering and using the lick. Definite social dominance of the mature elk keeps the younger and the disabled animals in the marginal area so that small secondary licks become established. Other species such as moose, mule deer and porcupines are driven out of the lick, usually not by individual fighting but by the massed approach of the group.

Trail patterns worked by the elk in the higher mountain ranges indicate their most elaborate way of commuting. Elk trails follow the contour of the hillside and do not climb extremely steep places as deer trails do. In meadows and grassland the trails often vanish because the elk groups "fan out." On slopes or in timber passages they reappear. Elk in general do not avoid wet, swampy places and many trails lead through such locations. Under pressure of a disturbance, however, the elk attempt to stay on firm ground, circumvent swampy areas and often endeavor to escape uphill.

III. RUTTING SEASON

A seemingly unorganized group of animals is apt to reveal a completely different picture when

³Snow games of the Olympic elk (*Cervus canadensis roosevelti* Merriam) were beautifully shown in the "Olympic Elk" film of the Crislers (Disney Prod.).

disturbed. In the present study, natural or man-made stresses were utilized and studies were made of the effect of the rutting and hunting season on herd structure. As control groups, the elk in protected National Park habitats were contrasted with those in hunted areas.

THE PERIOD OF UNREST

The transition from the peaceful summer range pattern to the rutting season pattern is extremely gradual. The first changes in behavior are detected in the bull groups and in the spikes. This period is designated as the pre-rutting season. The velvet on the fully-grown antlers begins to shrink and apparently to itch, and velvet-rubbing begins. What at first looks like a harmless tussle becomes more and more a practice sparring and even a short battle. Spikes and younger bulls which were previously members of the bull groups are now driven off one by one to a respectful distance or they are beaten off entirely. A few very young spikes may be tolerated a while longer. In early August spike bulls in the nursery cow group have occasionally been seen in a pre-rutting game. They playfully run to single out a cow, and bucking and kicking, drive her around. They may even bugle. The juvenile bugle is a little higher in pitch than the mature one and the other elk do not seem to pay much attention to it.

In the early stage of the rutting time unrest comes to the cow nursery herds. The weaning of calves is under way. Some cows kick the young or drive them off by other means; others continue nursing but with long intervals in between.

Summer range plateaus are grazed to the bare soil late in August when the snowdrifts have melted and the water-runs are scarce. The big herds first break into smaller groups and these graze the side slopes and creek bottoms. The summer range becomes deserted and the hitherto neglected secondary pastures come into use.

Here and there an early-rutting bull bugles and attempts to join a band of cows, but the confusion and apparent unreadiness of the cows keep him off. The general trend of the elk is to the lower country. Colder nights and the absence of food drive them to the lower stream beds. While this picture was true for all four elk habitats under observation in this study, another factor enters in two of the areas outside Yellowstone National Park. Here, the hunting-season opens just as the rutting season gets under way. This pressure creates a severe conflict situation.

The conflict pattern and the way it affected the different elk groups and ages will be described after the observations during a normal undisturbed rutting situation have been recounted.

RUTTING TIME IN AN UNDISTURBED HERD IN PROTECTED AREA (YELLOWSTONE PARK)

The stage of unrest gradually develops into the "rutting season" proper. Harem elk groups consisting in general of ten to fifteen cows with their calves can be observed in timber borders and meadows. The bull of the group circles the harem and often drives a particular cow. While the cows, yearlings and calves are grazing, the bull rarely takes time to graze. Bugling, roaring and watching the harem keep him fully occupied. A bugle made by a rival puts the bull into a rage and starts him on a widespread search for the intruder. One bull, seen tramping and sniffing through the underbrush, broke into a group of fir trees and after discovering a hiding bull, drove his rival away with sharp-sounding blows of his antlers.

Another factor contributing to instability of elk cows in harems was found to be the size of the harem, the large ones being most subject to unrest. Aggregates of twenty and more cows seemed too widespread when grazing. Often the bull, while rounding up cows at one end of a meadow, lost control of the other end of the group. Minor unattached bulls without harems, roaming the vicinity of the harem groups and looking for a chance to mate, then found that chance.

During the peak of the rutting season, the spike bull groups are completely by themselves and are driven away whenever they approach a harem group or meet a mature bull. Fear of the harem bulls brings them quite often out of the timbered slopes into dangerous situations facing the hunters rather than being beaten by a big bull elk.

THE RUTTING SEASON IN THE HUNTING AREA

For observations on the rutting season in the hunting area, test areas of approximately eighteen square miles each were selected on two summer ranges, at an altitude of 9,000-10,000 feet. Only four hunting camps were located here, and the remote wilderness area with a small number of camps was chosen because excessive pressure by large numbers of hunters on foot or in trucks and jeeps would have complicated and obscured the observation of events.

The area was visited at least three times a week for several weeks preceding the opening of the hunting season. Elk groups grazing and resting were noted. From the beginning of the hunting season, observations were made from overlook points daily for six days. Thereafter, three visits were made each week for three weeks.

It was found that the preparations for the hunting season "spook" a considerable number

of harems out of the hunting region into the safety of Yellowstone Park. Pack-trains with equipment, wood-chopping and tent-setting noises as well as grazing groups of horses with bells and hobbles ringing through the night contributed to the disturbance of the elk. The cows, not the bulls, gave the signal, or initiated the exodus into the safety zone.

The morning of the first hunting day, after the first volley of shots sounded (8:00 A.M.), the simultaneous flight of four different cow groups, three of which contained a bull, was spotted in the border zone of the Upper Snake River valley. The elk came down the slopes of the Big Game Ridge where the shots were fired. The escape, in quiet single and double file, led through the Snake River bed into the Crooked Creek slopes within the Yellowstone Park area. Elk groups resident in the borderline area were found grazing on three different slopes at the onset of the hunting season. Upon the sound of shots, some raised their heads, but the group continued to graze. Two of the groups, on their exodus from the hunting area, came upon these grazing groups, and mutual looking and sniffing took place. After a few minutes, the two retreating groups continued to the safety of the Park. The borderline elk stayed in their habitat despite further volleys of shots in the distance. Very few harems were found in the hunting areas after the second day following the opening of the hunting season. Erratic and transient elk bands or single animals were spotted frequently, however. Many confused spikes were encountered. This seems to indicate that in their state of intimidation by the bulls, the spikes disregarded the shooting and the commotion created by the hunting camps.

The fact that sight of the peacefully grazing elk bands did not stop the escaping groups was surprising, since elk, in general, will be quieted and "stabilized" by the sight of other grazing elk, or even by other grazing and undisturbed animals (wild geese, moose, deer).

The evasive migration of the groups after the opening of the shooting was characterized by a relatively long range, the animals fleeing from three to eight miles until they reached the safety areas. Mature cows were the leaders, whereas the bulls were not too eager to move. In fact, the appearance of the groups lost the "harem character" temporarily. No rounding up by the bull was observed. Rutting activity was resumed after the evasive migration was completed and after the group had quieted down for at least one day. Perhaps the bugling from elk established in the area of retreat contributed to resumption of the rutting activity.

The following pattern was found: In a situa-

tion of persecution, which was one of severe stress and strain, the elk reacted by evasion and rutting activity was curtailed, or perhaps even suppressed. The cows were the first to yield and to initiate the evasion; the bulls yielded more reluctantly. The bulls maintained certain aspects of the rutting behavior; they kept spikes at a distance and kept restless vigilance against other bull elk.

SUMMARY

In a long range study (7 years) an attempt was made to analyze the pattern of social behavior in groups of elk, or wapiti, of the Jackson Hole herd of Wyoming.

Elk were chosen because they are herd-living, have migratory habits and are still relatively free ranging. Consistent elk herd patterns were established in comparable habitats, seasons and situations. The group structure and its reorganization were analyzed from the spring migration to the rutting season. Natural and man-made disturbances provided test situations suitable for study of individual and group interaction.

Patterns of social behavior observed and analyzed dealt with the break-up toward spring of the huge elk aggregate in the winter refuge, into the swifter moving bull-spike bands and the cow-nursery herds.

Bull groups comprised several mature elk and a few spikes (yearlings). Tolerance to young bulls prevailed until the pre-rutting stage.

In the elk nursery herds the problem of leadership, the formation of calf pools, the shielding pattern, the training for migration and the displacement of the yearlings by the new calf were studied.

On summer range the merger of migratory groups into the large summer herd, the change in daily routine and in reaction to disturbances were observed. Favorable habitat increased play activity and social interaction. Social test situations yielded information on trailing patterns, shelter use, resting and flight patterns. Salt licks revealed extremely strict enforcement of social domination within species and conflict with other species.

In the pre-rutting and rutting season, the position of the spike bulls provided insight into conflict patterns. Group behavior during rutting season in undisturbed areas was compared with areas under hunting pressure. Evasive migration

took place, over-ruling and counteracting the natural migration during this season.

Interaction of elk groups under stress with elk free from stress was observed.

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